ATMOSPHERIC ELECTRICITY.

AURORAS.

Auroras were reported as follows: 3d, South Canisteo, N. Y. 5th, Beverly, N. J. 6th, Orono, Me.; South Canisteo, N. Y. 7th and 9th, Vevay, Ind.; Quakertown, Pa.; South Canisteo, N. Y. 11th, Salem Corners, Pa.; South Canisteo, N. Y. 12th, South Canisteo, N. Y. 14th, Vevay, Ind. 15–16th, Sandusky, Ohio. 16th, Orono, Me.; Davenport, Kimball, and Webster, S. Dak. 16–17th, Huron and Rapid City, S. Dak.; and Fort Buford, N. Dak. 17th, Newburyport, Mass.; Thornville, Mich.; and South Canisteo, N. Y. 17–18th, Saint Vincent, Minn. 18th, Green Bay, Wis.; Orono, Me.; Quakertown, N. Y.; and Salem Corners, Pa.

Sandusky, Ohio, 15th: at 10 p. m. a dark segment was observed above the northern horizon, extending from northwest to north-northeast, and at 10.30 p. m. beams of light appeared. The aurora attained its maximum brilliancy at 11 p. m., at which time the sky in the north was of a white misty appearance, while in the southeast the sky was illuminated by distant lightning. The display lasted until 2 a. m., 16th.

Huron, S. Dak., 16th: a brilliant aurora was observed at intervals from 10 p. m. until after midnight. Beams of light rose to about altitude 40°, and extended from north to east-northeast, producing a light which at times was almost as bright as that of the full moon.

Fort Buford, N. Dak.: an auroral light was observed 11.22 p. m., 16th, consisting of slender streamers of yellowish or straw color which had an upward and lateral motion and reached altitude about 60°. At 12.45 a. m., 17th, an arch of gray color formed, which rose to altitude 45°, and extended from northwest to east; at 1.30 a. m. the arch had receded some, the outlines were dimmer, and the streamers less numerous, and at 3 a. m. the aurora had disappeared.

Rapid City, S. Dak., 16th: a diffused auroral light, resembling the dawn of morning, was observed in the north from 11.30 p. m. until midnight. The light rose to altitude 45° and extended from azimuth 150° to 230°.

Saint Vincent, Minn.: a brilliant aurora was observed from 10.20 p. m., 17th, to 1.35 a. m., 18th. It consisted of 14 well-defined streamers, about one-half of which rose to altitude 70°, and varied in color at short intervals from a deep orange to a pale pink. The maximum brilliancy of the display occurred at 11.36 p. m., 17th, when the aurora extended from azimuth 160° to 225°.

Green Bay, Wis., 18th: an auroral display was observed at 2 a. m., consisting of an arch of white light in the north which rose to altitude about 15°, and extended from azimuth 135° to 225°. At altitude 25° in the northwest, a curtain-like appendage was seen.

THUNDER-STORMS.

The more severe thunder-storms of the month are described under "Local storms." East of the Rocky Mountains thunder-storms were reported in the greatest number of states, 32, on the 15th; in 31 on the 8th; in 25 to 30 on the 2d, 3d, 9th, 16th, 17th, and 18th; in 20 to 24 on the 1st, 4th, 7th, 13th, 14th, 19th, 20th, 24th, 26th, 28th, and 29th; and in 14 to 19 on the 5th, 6th, 10th, 11th, 12th, 21st, 22d, 23d, 25th, 27th, and 30th.

East of the Rocky Mountains thunder-storms were reported on the greatest number of dates, 29, in Fla. and Miss.; on 20 to 28 in Ark., Ga., Iowa, Kans., La., Mich., Minn., Mo., N. Y., N. Dak., S. C., Tenn., and Tex.; on 12 to 19 in Ala., Ill., Ind., Ky., Md., Mass., Nebr., N. H., N. J., N. C., Ohio, Pa., S. Dak., Vt., Va., and Wis.; and on 1 to 10 in Conn., D. C., Ind. T., Me., Mont., R. I., and W. Va. West of the Rocky Mountains thunder-storms were reported as follows: Ariz., 1st to 31st; Colo., 1st to 11th, and 13th to 31st; Cal., 21st; Idaho, 7th to 15th, 21st, 22d, 23d, and 28th to 31st; Nev., 1st, 4th, 12th to 19th, 25th and 26th; N. Mex., 1st, 2d, 3d, 5th, 6th, 7th, 9th, 10th, 14th, 15th, 17th, 18th, 22d, 23d, 24th, and 26th to 31st; Oregon, 1st, 16th, 17th, and 31st; Utah, 1st to 5th, 13th, 14th, 15th, 17th to 20th, 25th to 29th, and 31st; Wash., 1st, 2d, 5th, and 9th; Wyo., 2d to 5th, and 18th to 22d. There were no states and territories in which thunder-storms were not reported.

MISCELLANEOUS PHENOMENA.

DROUGHT.

Drought injurious to crops and vegetation prevailed in Kans., Nebr., S. Dak., Minn., Iowa, Mo., Ark., Tex., Tenn., Ky., Ill., Ind., Ohio, Mich., N. Y., Mass., Md., Va., N. C., S. C., and Ala. The following is a summary of reports on drought made by regular and voluntary observers of the Signal Service:

Kansas.—The small precipitation and remarkably high temperature, preceded by a hot and dry June, caused serious damage to crops not matured by the first of the month. At Concordia crops suffered severely; wells, that never failed before, were dry; and the Republic River was the lowest ever known in July. At Alton crops were dried up. At Downs corn was ruined. At Elk Falls corn was estimated about ½ crop, and wells were becoming dry. At Fremont nearly all crops and a large proportion of fruit trees were destroyed. At Havensville corn was estimated about ⅓ crop, and potatoes and small garden vegetables were a failure. At Allison 80 per cent. of most crops was ruined. At Sedan corn, pastures, and apples were reported drying up. At Shields grass was dried up and corn a failure. At Wakefield corn was an entire failure in many fields, and the average yield was estimated at ½ crop, and fruit and vegetables were suffering. *Nebraska.*—At Culbertson the pastures were very dry; potatoes were a failure; and, in most cases, wheat and oats did not pay for the seed sown. At Genoa corn was injured. At Howe the drought that was injuring all crops was broken on the 17th. At Lexington corn was nearly destroyed. *South Dakota.*—At Woonsocket the ground was exceedingly dry; wells were becoming dry; and all crops were unusually light. At Huron drought and hot winds had a bad effect upon late crops. At Webster vegetation was suffering. *Minnesota.*—At Montevideo and Sheldon crops were injured by drought. *Iowa.*—The month was characterized by periods of intense heat, with high winds and droughty conditions, making it one of the most unfavorable months for growing crops experienced since official observations have been taken. At Amana pastures and potatoes were suffering. At Dubuque the protracted drought was becoming serious in its results. At Blakeville all crops were injured. At Carson hot winds on the 6th, 7th, 13th, and 27th to 30th greatly damaged crops. At Clinton corn, potatoes, and pastures were suffering. At Des Moines the prospect for corn and potatoes was very poor; pastures were drying up; and cattle were suffering. At Fort Madison pastures were drying up; corn and garden vegetables were suffering; and wells were beginning to fail. At West Bend corn and potatoes were suffering. *Missouri.*—At Adrian all crops were suffering. Near Kansas City crops were reported a partial failure. At Harrisonville corn was injured. At Oregon crops and small fruit were damaged. At Platte River corn was injured. At Saint Charles all crops were suffering. At Steelville corn and pastures were injured. At Wither's Mills the corn crop seemed very light, and crops were suffering. *Arkansas.*—At Lead Hill corn and cotton were beginning to suffer, and in some localities corn appeared but about 25 per cent. of the usual crop. *Texas.*—At Mesquite the fruit crop was a failure; the long drought was broken by rain on the 4th. At Mountain Spring crops were almost a total

failure. At Ochiltree crops and feed for stock were nearly destroyed. *Tennessee.*—At Ashwood corn was injured. At Chattanooga crops were a failure; the drought was broken on the 21st. *Illinois.*—At Louisville crops suffered during the first half of the month. *Indiana.*—At Seymour crops were injured; pastures were badly withered; and stock suffered from heat and scarcity of feed. *Kentucky.*—The drought which prevailed until the 23d caused great injury to crops, and was especially severe in Jefferson county. *Ohio.*—At Kenton corn was almost a total failure, and in some parts of the county it appeared about ½ crop; potatoes were also injured. At Napoleon corn, oats, and grass were suffering. At Cincinnati serious injury was caused to vegetation. At Wauseon the yield of potatoes was estimated at ⅓ the usual crop, and corn was badly damaged. *Michigan.*—At Birmingham all crops were damaged. At Hudson the month was reported the driest July in 12 years; potatoes appeared about ⅓ crop, and wheat was very light. At Thornville great injury was caused to corn and potatoes. *New York.*—At New Lisbon corn and pastures were suffering. *Massachusetts.*—At Amherst crops suffered from drought until the 25th. At Royalston vegetation was injured. *Maryland.*—The drought was severely felt throughout the state; it was broken on the 23d. At Cumberland the month was dry and hot; garden vegetation suffered greatly, and springs and streams were very low. At Barren Creek Springs the drought was broken by rain on the 25th; corn was badly injured, and vegetation was injured or destroyed by drought. *Virginia.*—At Staunton corn and vegetation in general suffered. At Yancey's Mills vegetation suffered; the drought was broken on the 24th. *North Carolina.*—At Asheville corn and oats were injured. *South Carolina.*—The section from Fair Forest through Spartanburgh to Cedar Springs and Walnut Grove suffered from drought until the 24th. *Alabama.*—Drought during the first part of the month damaged corn and injured cotton to some extent.

PRAIRIE FIRES.

A large quantity of grain, barns, and other property were destroyed near Macksville, Kans.

SUN SPOTS.

Mr. C. E. Buzzell, Leaf River, Ill.: 4th, large group in view on east limb; also a small group 2 days past meridian. The small group faded out 5th, while the larger one completed the transit; it was greatly reduced 10th. 22d, large group came in view by rotation and completed the transit, undergoing many changes on the 27th. 28th, large spot by rotation, followed by prominent faculæ; unchanged and in view on 31st. 29th, one small spot in south latitude two days in on east limb, it faded out 30th.

Mr. John W. James, Riley, Ill.: none seen until 5th, then 8 or 10 spots surrounded by very prominent faculæ on eastern edge. 7th, 2 or 3 spots west of this group, which on the 8th had mingled into one. The group of 5th had vanished on the 11th. 14th, the single spot disappeared from west edge and reappeared, increased in size, on eastern edge, 28th. 15th, 16th, 17th, immense areas of faculæ on west limb. 18th to 24th, no observations. 25th, a group of 1 large and 5 to 7 small spots half way east of meridian. 27th, large spot breaking up; was very faint 31st.

Mr. M. A. Veeder, Lyons, N. Y.: spot groups appeared on 4th, 5th, 22d, 23d, and 28th. All these groups were of considerable size, and underwent many changes, persisting, more or less, throughout their transit. Faculæ were seen at the eastern limb 13th, 14th, 15th, and 27th, and at the western limb 16th and 19th.

H. D. Gowey, North Lewisburgh, Ohio: sun spots were observed 7th to 12th, and 25th to 31st.

Haverford College Observatory, Pa. (observed by Prof. F. P. Leavenworth):

Date.	Number of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Faculæ.	Remarks.
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	
July, 1890.										
1, 10 a. m...	0	0	0	0	0	0	0	0	0	Definition fair.
4, 10 a. m...	2	11	0	0	0	0	2	11	1	Definition good; 2 large spots.
5, 5 p. m...	0	11	0	0	0	0	1	22	3	Definition good; 4 large spots.
6, 5 p. m...	0	3	0	0	0	0	1	25	3	Definition fair; several large spots
7, 12 m	0	8	0	0	0	0	1	33	2	Definition fine; 2 large spots.
8, 11 a. m...	1	2	0	0	0	0	3	32	....	Definition good; 3 large spots.
9, 11 a. m...	0	15	0	0	0	0	2	48	0	Definition fair.
10, 11 a. m...	0	0	0	0	0	0	2	28	0	Definition fair.
11, 3 p. m...	0	0	0	0	0	0	2	10	1	Definition fair.
12, 11 a. m...	0	0	0	0	0	0	2	5	0	Definition poor.
14, 12 m	0	0	0	0	0	0	1	4	2	Definition fair.
15, 11 a. m...	1	2	1	4	0	0	1	2	2	Definition good.
16, 10 a. m...	0	0	0	0	0	0	0	0	1	Definition poor.
17, 11 a. m...	1	1	0	0	0	0	1	1	0	Definition fair; spots small.
18, 5 p. m...	0	0	0	0	0	0	0	0	1	Definition good.
19, 5 p. m...	0	0	0	0	0	0	0	0	1	Definition good.
20, 5 p. m...	0	0	0	0	0	0	0	0	0	Definition good.
21, 10 a. m...	0	0	0	0	0	0	0	0	0	Definition poor.
22, 10 a. m...	1	3	0	0	1	3?	1	3	1	Definition bad.
23, 12 m	1	6	0	0	0	0	2	9	2	Definition fair; 1 large spot.
26, 5 p. m...	0	16	0	0	0	0	1	20	0	Definition good.
27, 5 p. m...	0	0	0	0	0	0	1	12	1	Definition good.
30, 11 a. m...	3	3	0	0	0	0	4	13	1	Definition good; 1 large spot.
31, 10 a. m...	0	0	0	0	0	0	4	9	2	Definition good; 1 large spot.

VERIFICATIONS.

FORECASTS FOR 24 HOURS IN ADVANCE.

[Verifications made by Assistant Professor C. F. Marvin, assisted by Mr. H. E. Williams, chief clerk of the Forecast Division.]

The forecasts for districts east of the Rocky Mountains for July, 1890, were made by Captain James Allen, 3d Cavalry, Signal Officer, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant John P. Finley, Signal Corps.

Percentages of forecasts verified, July, 1890.

States.		States.	
Maine	80.4	Delaware	81.0
New Hampshire	81.2	Maryland	83.8
Vermont	79.6	District of Columbia	84.5
Massachusetts	78.1	Virginia	80.5
Rhode Island	78.5	North Carolina	83.8
Connecticut	75.8	South Carolina	83.7
Eastern New York	80.6	Georgia	82.5
Western New York	84.2	Eastern Florida	88.4
Eastern Pennsylvania	78.2	Western Florida	85.4
Western Pennsylvania	84.6	Alabama	86.6
New Jersey	81.4	Mississippi	84.2

Percentages of forecasts verified—Continued.

States.		States.	
Louisiana	87.5	Nebraska	84.1
Texas	93.5	Missouri	85.8
Arkansas	87.7	Colorado	79.0
Tennessee	83.5	North Dakota	87.4
Kentucky	87.7	South Dakota	82.6
Ohio	85.6	Southern California*	94.0
West Virginia	80.3	Northern California*	92.2
Indiana	87.4	Oregon*	84.7
Illinois	86.0	Washington*	85.8
Lower Michigan	82.1	*By elements:* Weather	86.4
Upper Michigan	77.9	Temperature†	78.2
Wisconsin	77.7		
Minnesota	78.8	Monthly percentage of weather and temperature combined‡	83.1
Iowa	84.6		
Kansas	82.9		

*In determining the monthly percentage of weather and temperature combined, the Pacific coast states are not included. †The forecasts of temperature in districts east of the Rocky Mountains for July, 1890, were made with reference to the maximum temperature alone; that is, a prediction of warmer or cooler indicated that the maximum temperature of the day designated would be higher or lower than the maximum of the previous day. ‡The monthly percentage of weather and temperature combined is determined by multiplying the percentage of weather by 6, and the percentage of temperature by 4, and dividing their sum by 10.